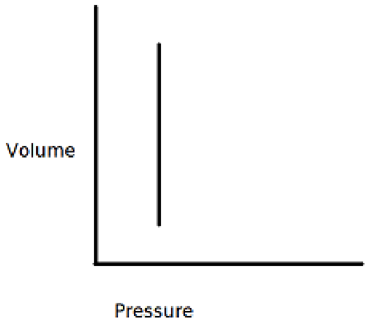
HW 2 PTV

1. Write the first law of thermodynamics.

   $\triangle U = Q + W$

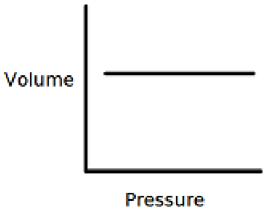
2. Define isobaric and tell what is zero during the process. Sketch the PV diagram.

   Isobaric processes involve no pressure change. $\triangle P = 0$



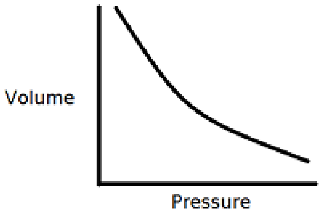
3. Define isometric and tell what is zero during the process. Sketch the PV diagram.

   Isometric (isovolumetric, isochoric) processes involve no volume change. $\triangle V = 0$



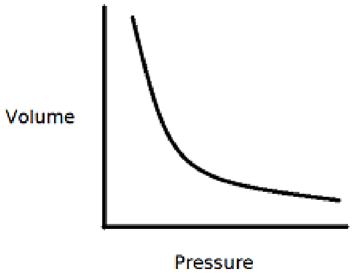
4. Define adiabatic and tell what is zero during the process. Sketch the PV diagram

   Adiabatic processes involve no transfer of heat or matter. $\triangle n = 0 \quad Q = 0$

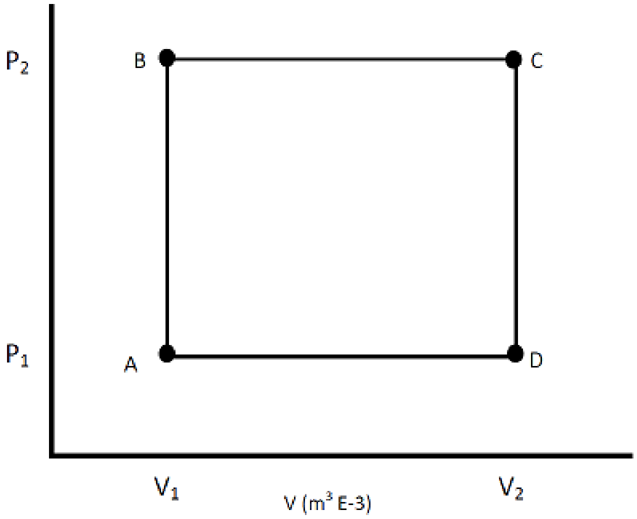


5. Define isothermal and tell what is zero during the process. Sketch the PV diagram

Isothermal processes involve no temperature change. $\triangle T = 0$



One mole of monatomic gas, initially at point A is taken through a 4-process cycle ABCDA as shown to the left. The initial conditions are T_A, P_1, V_1. The graph is scaled. (Three marks on the page separate P_1 and P_2 as well as V_1 and V_2, signifying that $P_2 = 5P_1$ and that $V_2 = 5V_1$)



6. What is the temp. at point B relative to point A?

$$T_B = T_A \frac{P_2}{P_1} = \boxed{5T_A}$$

7. What is the temperature at point C relative to point A?

$$T_C = T_A \frac{P_2 V_2}{P_1 V_1} = \boxed{25T_A}$$

8. Does internal energy increase or decrease during process AB? Explain.

   The internal energy increases because the temperature increases, which is known because the pressure increases while the volume stays constant.

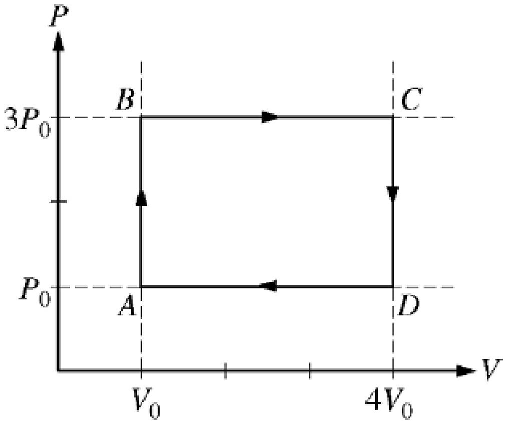
9. In which process(es) does the environment do work? Explain.

   The environment does work in process DA because it decreases the volume.

10. In which process(es) is heat removed from the system? Explain.

Processes CD and DA remove heat from the system. In process CD, since the pressure decreases and the volume stayed the same, then the temperature must have decreased. In process DA, the volume decreases while the pressure stays the same, so the temperature must have decreased.

A sample containing three moles of an ideal gas is taken through a series of equilibrium states, as represented by the closed path ABCDA in the diagram above. Rank the temperatures at the 4 labeled points from least to greatest, using 1 for the lowest temperature. If two or more points have the same temperature, give them the same ranking.



A: 1, B: 2, C: 4, D: 3

Determine the temperature at point D in terms of P_o and V_o.

$PV = nRT$

$P_o(4V_o) = nRT$

$T = \boxed{\frac{4P_oV_o}{3R}}$

Determine which of the processes in the cycle ABCDA, if any, for which the work done on the gas is positive. Explain your reasoning.

Work is done in process DA because the volume decreases.

In process AB, is the energy transferred to the gas by heating positive, negative, or zero. Explain your reasoning.

The energy transferred by heating is positive because the temperature increases (pressure increases while volume stays the same).

Derive an expression for the net work done on the gas during the entire process ABCDA. Express your answer in terms of P_o , V_o.

$Work = PV, P = \frac{F}{A}, V = A \times d, PV = \frac{F}{A}(A \times d) = F \cdot d = Work$

Work is done in process DA and process BC. The work done on the gas for BC is $-9P_oV_o$, and the work done on the gas for DA is $3P_oV_o$. You can find the work done by finding the area under the curve.

$3P_oV_o - 9P_oV_o = \boxed{-6P_oV_o}$